The U.S. Food Supply Series: Selected Food and Nutrient Highlights, 1909 to 2000

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The U.S. food supply data series, beginning with 1909, reports the amounts of nutrients available for consumption on a per capita and per day basis. Estimates of nutrients in the food supply are used to monitor the potential of the food supply to meet the nutritional needs of the U.S. population, to examine historical trends, and to evaluate changes in the American diet. Significant changes in food supply nutrients and food commodities providing these nutrients have occurred since 1909. This report[1] provides information on availability and consumption of the major food groups of the food supply; highlights nutrient availability and contributions of vitamin A, folate, calcium, and potassium from these food groups for 1909, 1945, 1970, and 2000; and provides a discussion of critical events since 1909 that were responsible for changes in nutrients and food commodities in the U.S. food supply.

The variety and types of food commodities in the U.S. food supply and the nutrients they provide have undergone significant changes since 1909. In the 1930s, advancements in food-processing technologies introduced into the marketplace canned, frozen, and packaged items such as canned soups and vegetables, frozen vegetables and fruits, and packaged cereals. The result has been an increase in national availability and shelf life of these foods. During the 1930s, margarine was fortified with vitamin A and beta-carotene (for color) and milk was fortified with vitamins A and D. In the 1940s, flour and flour products were enriched with thiamin, riboflavin, niacin, and iron. Such events ensured an adequate supply of some nutrients and enhanced the healthfulness of the U.S. food supply.

During the second half of the 20th century, changes in animal husbandry and marketing practices resulted in different nutrient composition and forms of red meat and poultry, such as leaner meat cuts and a variety of poultry products. Over the last three decades, an increase in ethnic diversity, more elderly consumers, and the expansion of government-mandated nutrition policies[2] changed the demand for some foods and expanded the variety of others. These events resulted in changes in commodities and nutrients in the food supply (see box). For example, in 2000, the food supply provided a greater variety of grain products, fruits and vegetables, reduced-fat meats, and dairy products than was the case in 1970; however, during 2000, the food supply also provided higher amounts of caloric sweeteners and added fats. The increased variety and availability of grain products, along with changes in grain fortification policy during this

[1]For the full report, see Gerrior, Bente, and Hiza (2004).

[2]These policies included mandatory nutrition labeling of purchased foods, revision of the U.S. grain fortification policy, publication of the *Dietary Guidelines for Americans*, and the development of the Recommended Daily Allowances (RDAs) and the Dietary Reference Intakes (DRIs).

Availability of Food Groups of the Food Supply

Throughout the U.S. food supply series, substantial changes occurred in the availability or per capita consumption of many of the major food groups. Many of these changes were linked to advances in food production and technology, Federal standards for enrichment and fortification, the Federal Dietary Guidance System, or increasing consumer demand for nutritionally improved foods. Based on food supply per capita estimates, the following trends are noted.

Meat, Poultry, and Fish Group; and Meat Alternates

Per capita consumption from the meat, poultry, and fish group increased during the period 1909 to 2000. Although consumption of red meat reached a record high in 1971, per capita consumption was lower in 2000. Alternately, per capita consumption of poultry increased dramatically from the early and mid-1970s, almost doubling in 2000, and thus contributed to the overall increased availability from this group in 2000. Fish consumption also increased somewhat from 1909 to 2000.

The consumption of eggs, a meat alternate, reached record-high levels from 1950 to 1951. Egg use generally declined over the series, remained stable from 1989 to 1997, but increased in 2000. The consumption of legumes, nuts, and soy products generally remained stable in 2000.

Milk and Milk Products

The demand for whole milk has declined; whereas, the demand for cheese, lowfat and skim milks (fat-free or nonfat), and yogurt has increased substantially. Per capita use of lowfat and skim milks nearly doubled; whereas, cheese increased sixfold from 1909 to 2000. A demand for hard cheeses used in pizza making, an increased use of cheeses in prepared foods, and the development of processed cheeses are mostly responsible for the increase in per capita cheese consumption.

Vegetables and Vegetable Juices

Per capita consumption of vegetables and vegetable juices in 2000 was somewhat higher than was consumption in 1970 but substantially lower than it was in 1909. Consumption of vegetables generally declined over the series; however, vegetable use increased during World War II because of the popularity of U.S. “victory gardens” (vegetables).

Since 1920, the decreased use of fresh vegetables was due to the marked decline in the use of fresh white potatoes and a shift from fresh to frozen potatoes. This shift is associated with the increased popularity of fried potatoes (especially french fries) at fast-food restaurants. This decline has been slightly offset since the 1980s because of the increased consumption of other fresh vegetables, such as bell peppers, onions, and broccoli. Also, beginning in 2000, ERS’s data on vegetable consumption were expanded to include fresh pumpkin, several leafy greens, and okra, which was reflected in the increased consumption of dark-green and deep-yellow vegetables in 2000.

Fruits and Fruit Juices

Consumption of fruits and fruit juices increased from 1909 to 2000 with the per capita availability of citrus fruits and juices increasing by about fourfold. Since the early 1970s, use of non-citrus fruits and melons has generally increased. Increased availability of fruits is related to increases in juice consumption and the introduction of a greater variety of fruits, including tropical fruits (e.g., kiwi, pineapple, and mangoes) into the food supply.

Grain Products; Sugars and Sweeteners

The per capita use of grain products increased in 2000 from a low usage in 1972. Despite this 50-percent increase in grain products, consumption in 2000 was still lower than it was in 1909. In contrast, consumption of sugars and caloric sweeteners increased sequentially over the series. Between 1945 and 2000, this consumption increased by about two-thirds, reflecting the increased consumption of carbonated soft drinks and other sweetened beverages, such as fruit drinks and ades. Use of corn sweeteners surpassed the use of refined sugar in the mid-1980s and reached an all-time high in 1999.

Fats and Oils

Consumption of fats and oils remained relatively stable through 1945 but has generally increased since then. Over the series, a shift has occurred from the use of animal sources to vegetable sources because of a substantial increase in the use of vegetable-fat products, such as margarine, shortening, and salad and cooking oils. The increase in total fats and oils since 1970 probably resulted from the greatly expanded use of fried foods by the fast-food industry and in food service outlets, as well as the increased use of salad oils consumed both at home and away from home.

period, were responsible for the higher levels of folate in the 2000 food supply.

This report provides information on availability and consumption of the major food groups of the food supply; highlights nutrient availability and contributions of vitamin A, folate, calcium, and potassium from these food groups for selected years (1909, 1945, 1970, and 2000[3]); and provides a discussion of critical events since 1909 that were responsible for changes in the U.S. food supply.

The Source and Importance of Food Supply Data

The U.S. food supply data series measures the amount of food available for consumption per capita per year and the amount of nutrients available for consumption per capita per day. This series is the only continual source of data on food and nutrient availability in the United States dating back to 1909. Food supply nutrient estimates were calculated for the first time during World War II to assess the nutritive value of the food supply for civilian use in the United States and to provide a basis for international comparisons with the food supplies of our allies (U.S. Department of Agriculture [USDA], 1949; Gerrior & Bente, 2001).

Per capita food supply estimates provide unique and essential information on the amount of food and nutrients available for consumption. They are useful for assessing trends in food and nutrient consumption over time, for monitoring the potential of the food supply to meet the nutritional needs of Americans, and for examining relationships between food availability and diet-health risk. In particular, food supply data provide useful information to policymakers who are responsible for establishing food and nutrition policy.

Methods Used to Calculate Availability and Consumption

The USDA's Economic Research Service (ERS) annually calculates the amount of food available for consumption on a per capita basis in the United States. Food supply data measure national consumption of about 400 basic commodities. For most commodity categories, the available food supply is measured as the sum of beginning inventories, annual production, and imports minus exports, farm and nonfood uses, and end-of-year inventories. Per capita consumption is calculated by dividing the available food supply by the total U.S. population as of July 1 each year (Putnam & Allshouse, 1999).

Using per capita consumption data and information on the nutrient composition of foods from USDA's Agricultural Research Service, the Center for Nutrition Policy and Promotion calculates the nutrient content of the U.S. food supply. Per capita consumption for each commodity is multiplied by the amount of food energy and also by each of 27 nutrients and dietary components in the edible portion of the food. Results for each nutrient from all foods are totaled and converted to amount of nutrient per capita per day. Nutrients added through fortification and enrichment are also included in the nutrient content of the food supply. Because food supply data represent the disappearance of food into the marketing system and no adjustments are made for food waste, per capita consumption and nutrient estimates typically overstate the amount of food and nutrients people actually ingest.

In 1998, ERS published a method to adjust food supply data for losses due to food waste and to express the data in terms of Food Guide Pyramid serving recommendations (Kantor, 1998). This methodology expanded the usefulness of food supply data by allowing researchers and policymakers to gauge food availability in terms of current dietary guidance and Americans' progress in following the *Dietary Guidelines for Americans*.

Since 1943, the nutrient adequacy of the food supply was assessed in terms of the Recommended Dietary Allowances (RDAs)[4] for macronutrients, vitamins, and minerals (i.e., food energy, vitamin A, iron, and calcium). The RDAs have been revised and replaced with the Dietary Reference Intakes (DRIs) by the National Academy of Sciences (NAS). The DRIs expand upon the RDAs, including them as goals for intake by individuals and including three additional types of reference values: Estimated Average Requirements (EARs) for group assessment; Adequate Intake (AI), a specific indicator of adequacy; and Tolerable Upper Level (UL), a specific indicator of excess.

[3]The years 1909 and 2000 represent the initial and final years of the food supply series for which data are currently available; 1945 reflects increased food production of a number of foods associated with World War II and advances in enrichment and fortification during the 1930s and early 1940s; 1970 serves as a benchmark year for a review of food supply estimates over the past 30 years.

[4]The RDAs were formulated by the Food and Nutrition Board of the National Academy of Sciences (NAS).

Since the U.S. food supply accounts for food and nutrient availability on a national level, the EARs are used to assess food supply nutrients. For some nutrients, NAS has not determined an EAR, so an AI is used for population studies. While the AI is a less robust indicator of population nutrient intake than of individual intake, it is still a useful measurement to assess the availability of a nutrient to satisfy the needs of all individuals in a population or group (Yates, Schlicker, & Suitor, 1998).

Availability and Contribution of Selected Nutrients

Vitamin A

Vitamin A is a fat-soluble antioxidant essential for vision, growth, bone development, development and maintenance of epithelial tissue, integrity of the immune system, and reproduction. A variety of foods rich in vitamin A and provitamin A carotenoids is available in the U.S. food supply; thus, overt symptoms of vitamin A deficiency are rare. Vitamin A occurs as either preformed retinoids or carotenoids. Preformed vitamin A is abundant in some animal-derived products; whereas, provitamin A carotenoids are abundant in darkly colored fruits and vegetables and red palm oil. Beta carotene is the most active of the carotenoids. Both preformed retinoids and carotenoids are converted to retinol in the body.

Historically, Retinol Equivalents (REs) have been used to calculate the vitamin A activity of foods in the food supply; however, in 2001 the NAS released new guidelines for estimating the amount of provitamin A carotenoids needed to synthesize one unit of retinol (Institute of Medicine [IOM], 2001). Retinol Activity Equivalents (RAEs) are now the unit used to indicate vitamin A activity. The RAE is based on recent studies, which show that the conversion of provitamin A carotenoids to retinol is only half as great as previously thought (IOM, 2001). As such, retinol activity in the food supply may be lower than previously reported as vitamin A (RE). However, the U.S. food supply reports an abundance of vitamin A-rich foods; therefore, the EAR for the U.S. population is achievable through the diet.

Total vitamin A availability increased from 1,080 µg RAE per person per day in 1909 to 1,260 µg RAE per person per day in 2000 (table 1). Levels of vitamin A availability were highest in 1945: 1,300 µg RAE per person per day because of increases in the World War II food supply of foods rich in vitamin A that included foods from home "victory gardens" (vegetables).

The meat, poultry, and fish group was the leading source of vitamin A in both 1909 and 2000; however, this contribution dropped from 40 percent in 1909 to 27 percent in 2000 (fig.1). Organ meats accounted for an appreciable amount of vitamin A from this group in the earlier years of the series, but more recent use has declined. The vegetable group was the second leading source of vitamin A in both 1909 and 2000, providing 19 and 24 percent, respectively, to the total vitamin A in the food supply. Dark-green and deep-yellow vegetables accounted for most of the vegetable contribution to vitamin A.

When µg RAE is used as the assessment reference, one finds that the vitamin A activity of provitamin A carotenoids is half the vitamin A activity assumed when using µg retinol equivalents (RE) (IOM, 2001); therefore, vitamin A contributions from vegetables reported here are less than those in previous, similar reports and also lower than some readers may expect. The dairy group was the third leading source of vitamin A, providing 16 percent in 1909 and 22 percent in 2000. This rise was due to increased use of yogurt and frozen desserts. Fortification of margarine with vitamin A (since the mid-1940s) and breakfast cereals (beginning in 1974) has also made important vitamin A contributions to the total vitamin A content of the food supply.

Folate

Folate functions as a coenzyme and is essential for the biosynthesis of nucleic acids and normal maturation of red blood cells. Low levels of serum folate have been associated with elevated serum homocysteine, an independent risk factor for vascular disease and, during pregnancy, with an increased risk for neural tube defects.

The DRI for folate considers its bioavailability from a particular food source (IOM, 1998). Thus, folate is reported in units of dietary folate equivalents (DFE)—taking into account the significant differences in its absorption from different foods. Earlier analyses utilized enzymatic digestion to determine folate contents. This approach is now believed to have significantly underestimated the available amount of folate in many foods (Yates, 2001). To account for this change and to capture better the different forms of folate and folate bioavailability from foods, scientists now report folate levels in the food supply as total folate (µg) and as folate DFE µg. This method of reporting should substantially improve information on the folate available for consumption on a per capita basis or on a national basis (Yates, 2001; Lewis, Crane, Wilson, & Yetley, 1999).

The lowest level of total folate and folate DFE in the food supply was in 1965, at 278 and 277 µg per person per day, respectively (data not shown).

Table 1. Nutrients available (per person per day) in the U.S. food supply, selected years

	1909	1945	1970	2000
Food energy (kcal)	3500	3300	3300	3900
Carbohydrate (g)	501	429	389	490
Fiber (g)	30	26	19	24
Protein (g)	101	104	96	110
Fat (g)	122	138	151	170
Saturated fatty acids (g)	52	55	53	54
Monounsaturated fatty acids (g)	47	54	61	72
Polyunsaturated fatty acids (g)	13	18	26	36
Cholesterol (mg)	450	540	470	430
Vitamin A (µg RE)	1240	1540	1460	1670
Vitamin A (µg RAE)	1080	1300	1220	1260
Carotene (µg RE)	430	560	480	720
Vitamin E (mg)	7.2	10.5	13.3	19.2
Vitamin C (mg)	98	119	104	126
Thiamin (mg)	1.6	2.1	1.9	2.9
Riboflavin (mg)	1.9	2.6	2.3	2.9
Niacin (mg)	18	22	21	32
Vitamin B_6 (mg)	2.3	2.1	2.0	2.4
Total folate (µg)	328	351	290	691
Folate DFE (µg)	327	350	290	907
Vitamin B_{12} (µg)	8.5	9.4	9.5	8.3
Calcium (mg)	770	1080	930	960
Phosphorus (mg)	1520	1690	1510	1670
Magnesium (mg)	390	410	330	380
Iron (mg)	14.3	16.5	15.6	23.1
Zinc (mg)	13.5	13.2	12.3	14.9
Copper (mg)	1.7	1.8	1.5	1.9
Potassium (mg)	3830	4130	3480	3740
Sodium (mg)	940	1180	1360	1330
Selenium (µg)	168.5	150.3	127.0	176.3

Vegetables were the leading source of folate DFE prior to 1974, accounting for nearly 29 percent of the folate in the food supply in 1909; grain products were second, providing 24 percent of folate DFE to the U.S. food supply.

This low level was due to the decreased use of grain products and vegetables, mostly potatoes. Both folate measurements remained similar over the series until 1974, when cereal fortification (containing the synthetic form of folate) resulted in higher values for folate DFE than for total folate. In 1998, with mandatory folate fortification of processed grain products, both measures of folate increased as expected. Folate DFE levels, however, were about 30 percent higher than those for total folate (data not shown). The highest level of total folate (691 µg) and folate DFE (907 µg) per person per day was in 2000 (table 1).

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the food supply in 1909; grain products were second, providing 24 percent of folate DFE to the U.S. food supply (fig. 2). From the late 1940s through the mid-1970s, folate contributions from grains dropped significantly because of a decreased use of grain products. Until folate fortification of breakfast cereals, the legumes, nuts, and soy group consistently provided about one-fifth of the total folate in the food supply.

Calcium

Calcium is essential for the formation of bones and teeth; and requirements are highest during adolescence, later adult years, pregnancy, and lactation. Calcium is very important from a public health perspective because inadequate intake may increase the risk of osteoporosis—a condition of reduced bone mass resulting in increased skeletal fragility. Osteoporosis affects 25 to 30 million Americans. The important role of calcium intake to bone health and osteoporosis prevention was the primary consideration of the Food and Nutrition Board to increase dietary calcium recommendations for setting the new requirement (Bryant, Cadogan, & Weaver, 1999; IOM, 1997). The DRIs for calcium are reported as AIs and are used to report calcium availability in the food supply.

The amount of calcium available in the food supply has shifted over the years. Increased use of whole, canned, and dried milk as well as cheese resulted in an increase in calcium levels by 40 percent between 1909 and 1945 when calcium reached a peak value of 1,080 mg per capita per day (due to the production levels associated with the war years). From the mid 1940s through the early 1980s, calcium levels generally declined. Since then, however, levels have tended to increase because of a greater use of lowfat and skim milks, yogurt, and cheese.

Figure 1. Percent contributions from vitamin A (RAE) in the U.S. food supply, selected years

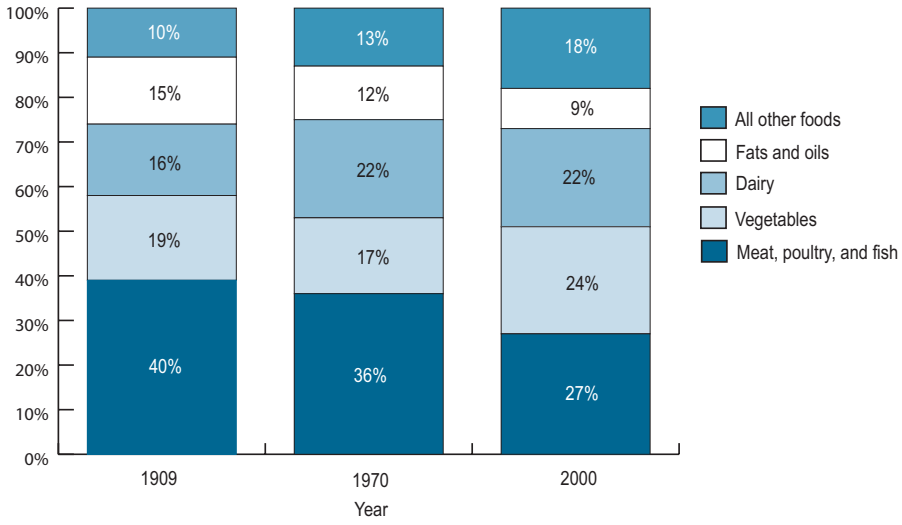


Figure 2. Percent contributions from folate DFE in the U.S. food supply, selected years

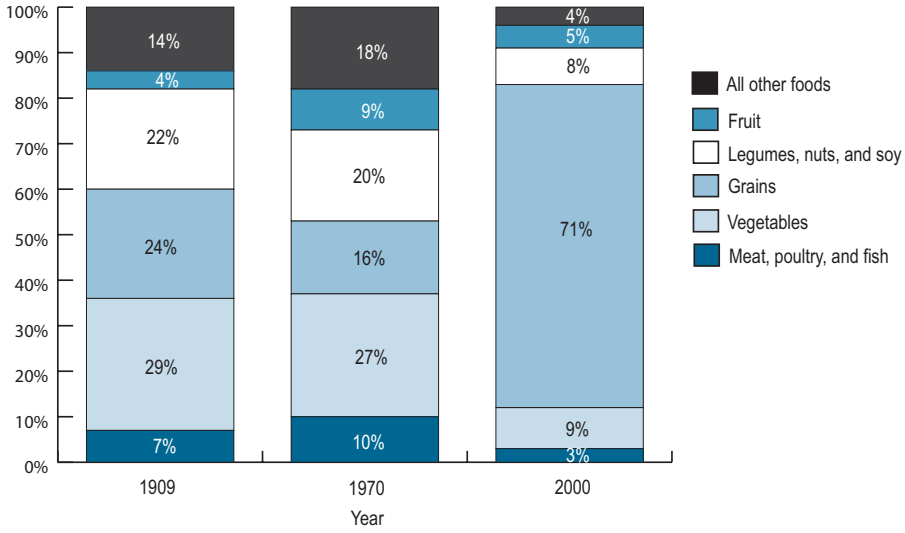
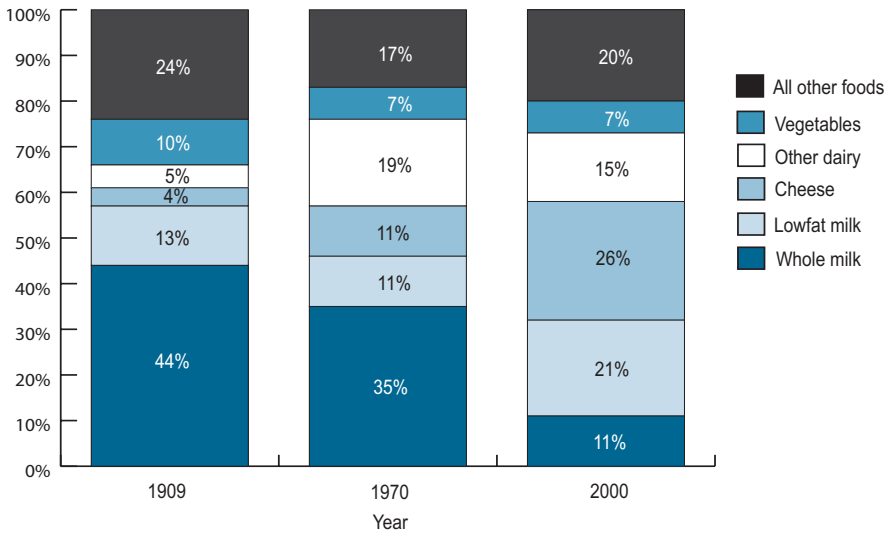


Figure 3. Percent contributions from calcium in the U.S. food supply, selected years



Dairy products have always been the predominant source of calcium in the food supply; however, a shift within the dairy group from whole milk to lowfat and skim milks has occurred over the years.

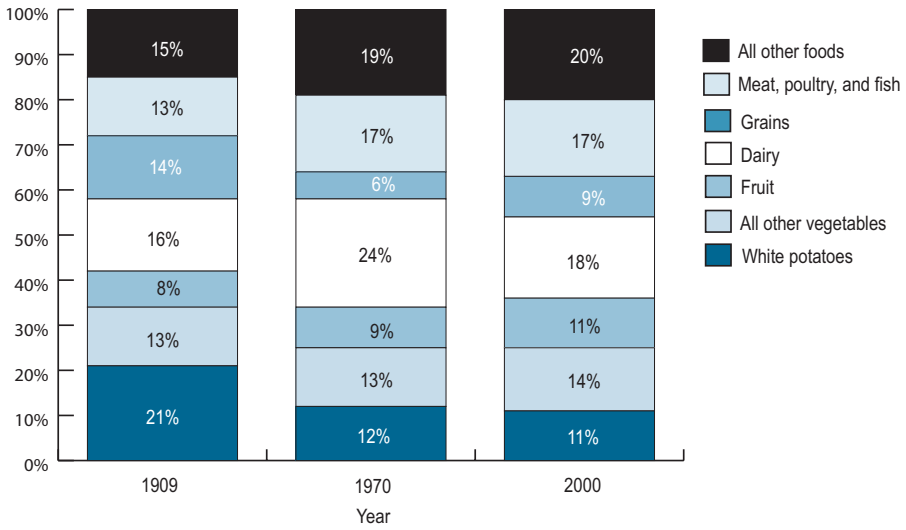
Dairy products have always been the predominant source of calcium in the food supply; however, a shift within the dairy group from whole milk to lowfat and skim milks has occurred over the years (fig. 3). In 1909, whole milk accounted for 44 percent of the calcium in the food supply; whereas, in 2000, it contributed only 11 percent. Even though the share of calcium contributed by lowfat and skim milks has increased, this share does not completely compensate for the calcium loss due to the decreased use of whole milk. The share of calcium provided by cheese was more than six times higher in 2000 (at 26 percent) than in 1909 (at 4 percent). The share of the vegetable group contributing to calcium in the U.S. food supply series has generally declined, dropping from 10 percent in 1909 to 7 percent in 2000.

Potassium

Potassium aids in muscle contraction and in maintaining fluid and electrolyte balance in body cells; it functions in nerve impulses as well as in carbohydrate and protein metabolism. The DRI committee could not determine an EAR for potassium; therefore, the AI is used to report calcium availability in the food supply.

During the earlier years of the food supply data series and during World War II, potassium levels were generally higher in the food supply. This was due to the high use of dairy products and vegetables. From the peak level of 4,130 mg potassium per person per day in 1945, values primarily fluctuated but were mainly on the decline. Potassium values dropped 390 mg per person per day between 1965 and 2000: 3,350 to 3,740 mg. Even though there has been a general increase of potassium levels since the mid-1980s—primarily because of an increase in fruit use—potassium levels available from the U.S. food supply in 2000 may not be sufficient to meet the current AI for adults (4,700 mg per day). Evidence indicates that this level of potassium intake derived mainly from food that is naturally high in potassium, such as fruits and vegetables, should reduce blood pressure, limit the adverse effects of sodium chloride on blood pressure, lower the risk of kidney

Figure 4. Percent contributions from potassium in the U.S. food supply, selected years



stones, and possibly reduce bone loss. In U.S. population groups with lower intakes of potassium, such as African Americans, there is a higher prevalence of elevated blood pressure and salt sensitivity, suggesting that such groups would especially benefit from an increased intake of potassium (IOM, 2004).

Foods from plants (e.g., grains, fruits, vegetables, legumes, nuts, and soy) have been the primary sources of potassium. Over the series, the leading source of potassium has been the vegetable group, followed by the dairy and the meat, poultry, and fish groups. In 1909, foods from plants (grains, fruits, and vegetable sources) provided 70 percent of the potassium in the food supply (fig. 4). Even though this percentage decreased over the years, foods from plant sources still provided 65 percent in 2000. This decreased contribution is attributed to the decline in the consumption of vegetables, particularly white potatoes. In the early years of the series, vegetables contributed 34 percent of the potassium in the food supply, with white potatoes alone contributing 21 percent. By 2000, the share from potatoes had dropped by about one-half and vegetable contributions dropped overall to 25 percent of the potassium in the food supply.

On the other hand, the contribution from fruit has generally increased over time, from 8 percent in the early 1900s to 11 percent in 2000. The share of potassium provided by the dairy group increased somewhat, from 16 percent in 1909 to 18 percent in 2000, as did the share provided by the meat, poultry, and fish group (from 13 to 17 percent, respectively, during this period). However, the share from grains decreased from 14 percent in 1909 to 9 percent in 2000.

Conclusions

Advances in food production and fortification technologies resulted in increased availability of foods and nutrients in the U.S. food supply. The recent release of the Dietary Reference Intakes provides new nutrition knowledge for analysis of nutrient availability in the food supply in terms of nutrient needs. The food supply will continue to provide a safe source of nutritious foods in the years ahead and to reflect changes in marketing practices, food technologies, and consumer demand.

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